

U. S. 52 IMPROVEMENT STUDY

FORSYTH COUNTY
WINSTON-SALEM

Executive Summary

US 52 is the primary north-south route in Forsyth County. The section of US 52 this study examines is from I-40, south of downtown Winston-Salem, extending twelve miles north to NC 65. This four lane facility is one of the most congested freeways in the triad region with over 79,000 vehicles utilizing it daily. US 52, designed as a thoroughfare for through trips, acts instead, as a connector for local commuters. Local traffic use this freeway for short local trips, instead of using the surrounding city streets. With I-74, a new interstate route originating in Michigan and merging with US 52, this facility will carry additional traffic along its already congested corridor until the bypass is constructed around Winston-Salem.

Traffic volumes along US 52 are a major concern because capacity exceeds supply during peak periods. The AM peak period volumes range from approximately 48,000 vehicles per day (vpd) north and south of the city limits to 79,000 vpd in the Central Business District (CBD). By the year 2025, these volumes are projected to increase to 138,000 vpd in the north and south to 127,000 vpd in the CBD. Existing and projected traffic volumes, coupled with the closely spaced interchanges and ramps present safety concerns for motorists maneuvering on and off the freeway.

The Level of Service (LOS) of the facility was analyzed using the Highway Capacity Software and the feasibility study by Howard, Needles, Tammen & Bergendoff (HNTB). Traffic volumes at the northern and southern limits of the study indicate an acceptable LOS D or better, but within the CBD, where traffic volumes crest to approximately 800 vphpl, the LOS is unacceptable for urban freeways. Since the existing facility operates below acceptability, the interstate traffic from I-74 could potentially worsen the situation.

Accident reports for the study area were compiled and analyzed by the Accident Studies section of the Traffic Engineering Branch. According to a three year study (May 1991 to April 1994) prepared by the Traffic Safety unit, 53% of the accidents that occurred on US 52 were rearend collisions. An additional 24% involved vehicles that ran off the road in an effort to avoid a stopped vehicle or slowing traffic. A majority of the accidents occurred during the morning and afternoon peak periods. This type of accident history is indicative of congested, fluctuating traffic conditions.

To alleviate the problem, Spot Safety and Traffic System Management (TSM) and Advanced Traffic Management Systems (ATMS) improvements are recommended. The spot safety strategies include lengthening auxiliary lanes, ramp reconfigurations, ramp closures and improved ramp geometry. ATMS strategies include ramp metering, detection devices, lane control signs for traveling on the shoulder during peak periods and system integration. These strategies and improvements will function as a short term initiative to improve the safety and increase capacity along US 52.

I. Background

Winston-Salem is the fifth largest city in North Carolina with a current population of approximately 170,000. Because of its significant growth in automobile use over the last ten years, congestion and safety are major concerns. One of the most congested corridors in the state, US 52, is the focus of this study. The corridor extends from I-40 Bypass south of downtown Winston-Salem to NC 65 in northern Forsyth county. The corridor is currently a four lane divided freeway with two 12 foot lanes in each direction. The existing right-of-way is full control of access and has seventeen interchanges within the 12 mile study area.

Presently, the operational safety of the corridor has been impacted by existing and projected traffic volumes. With over 79,000 vehicles per day (vpd) using US 52, it operates at a level of service F (LOS F) near downtown during peak periods. The Level of Service gradually improves to the north and south of the Central Business District (CBD). Travel demand projections for the year 2025, using North Carolina Department of Transportation's (NCDOT) travel demand model, are illustrated on Figure 1. With the designation of a new interstate route, I-74, and the completion of the proposed Eastern Beltway, traffic on US 52 is still projected to increase by 10%.

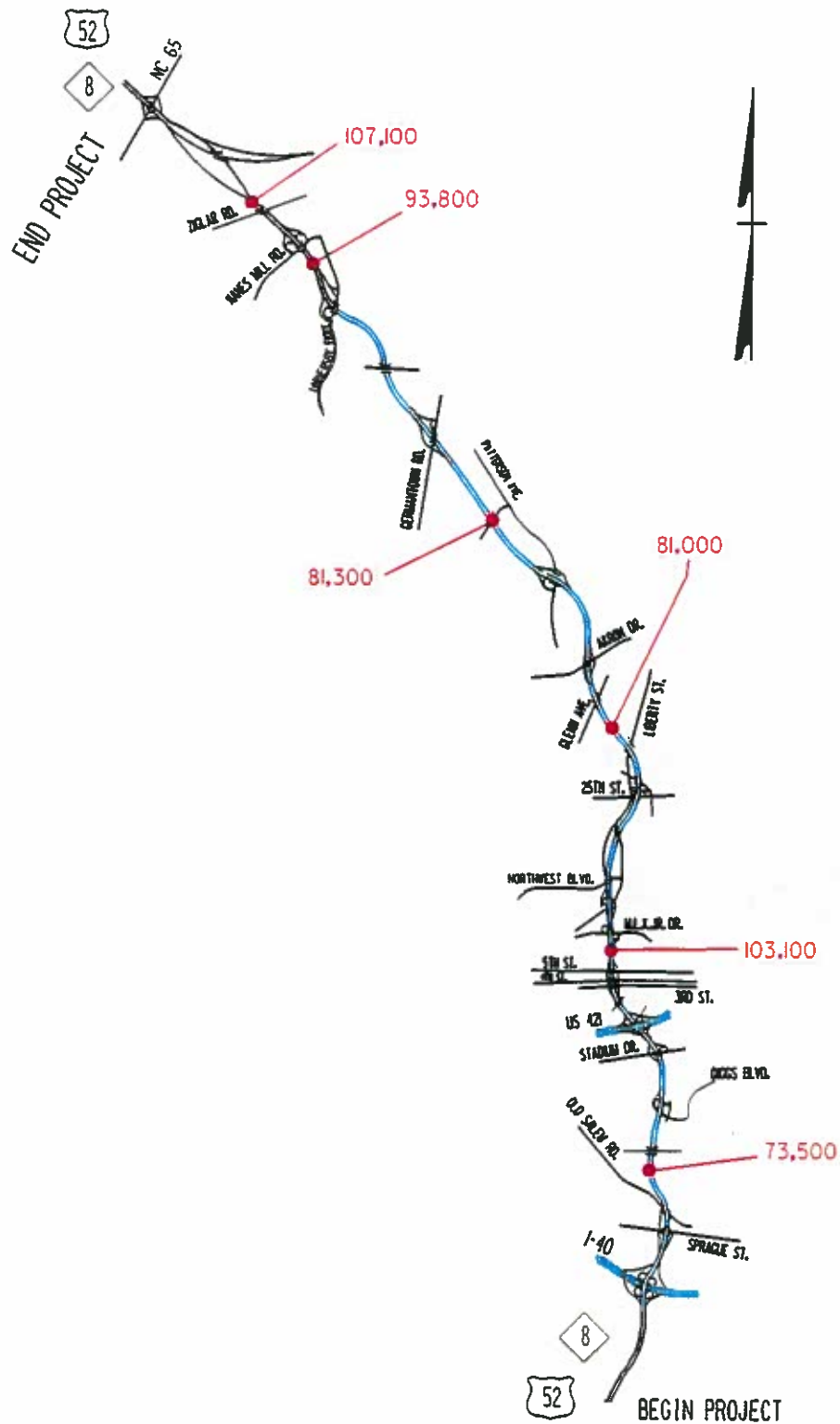
II. Scheduled and Active Projects

According to the current Transportation Improvement Program (TIP), there are several scheduled projects that will impact the capacity and efficiency of the US 52 corridor. TIP project B-2554B & C propose to rehabilitate bridges along US 52 from Martin Luther King, Jr. Drive to Glenn Ave.

TIP project U-2579 will construct the eastern loop of the Northern Beltway between I-40 Business (US 421) and US 52. The western section of the Northern Beltway (TIP #R-2247) is proposed to be constructed from US 158 to US 52. When completed, this multi-lane expressway will provide a bypass around the city of Winston-Salem for heavy trucks and thru traffic which would help reduce traffic congestion for motorists whose destination is not Winston-Salem.

Two new interstate corridors, I-73 and I-74, are proposed to bisect the triad region in the future. I-74 will originate in Michigan and join US 52 in Winston-Salem and continue around the eastern side of Winston-Salem with the Northern Expressway and link with US 311. Interstate 73 will link with US 220 in Guilford County. These two interstates will eventually merge in North Carolina and carry traffic into South Carolina. This multi-lane expressway will provide a bypass around Winston-Salem but no significant reduction in volumes will be noticed within the Central Business District (CBD) of US 52. Until the completion of the Northern Expressway, US 52 will continue to carry interstate traffic.

U. S. 52 (FORSYTH COUNTY) 2025 PROJECTED AVERAGE DAILY TRAFFIC VOLUMES



III. Scope

The study area of US 52 extends from the I-40 Bypass, south of the CBD of Winston-Salem, approximately twelve miles north to an interchange with NC 65. Within the study limits are seventeen (17) closely spaced interchanges and forty-seven (47) bridges. Operational and safety hazards are primary concerns due to high traffic volumes as well as maneuvering difficulties within the CBD.

In this study, advanced transportation management systems applicable to this area in terms of user needs, cost, and right-of-way limitations are investigated. These recommended strategies provide an efficient, cost-effective means to increase capacity along the US 52 corridor. This report details technical and functional requirements of a comprehensive short term deployment including an optimum schedule with proposed projects as well as the functionality of this corridor, once the outer loop construction is completed.

IV. Development of project plan

A project plan is developed to relieve the congested conditions on the US 52 corridor and provide additional capacity during peak periods. High volumes of traffic create capacity problems especially within the CBD. As volumes increase, traveling conditions worsen, thus making weaving maneuvers more difficult to perform. Closely space interchanges within the CBD create maneuvering difficulties which increase the accident rate and ultimately cause a complete breakdown of the facility.

Howard, Needles, Tammen, & Bergendoff (HNTB) performed a feasibility study which identifies five alternatives to alleviate the congestion and capacity problems on US 52. The alternatives include No-Build, Transportation System Management (TSM) alternative, Spot safety Improvement alternative, Interstate alternative (I-74), and a Combination option of TSM improvements and the Interstate alternative. A combination of Traffic System Management and Spot Safety improvements could be done quickly along with programmed rehabilitation projects in this area to alleviate congestion in the region until the construction of I-74 can be completed.

V. Recommended Improvements

The recommended improvements involve TSM strategies as well as Spot Safety initiatives. TSM strategies will maximize the efficiency of the existing roadway by managing traffic congestion. The TSM strategies considered for this roadway include pavement reinforcements for peak hour travel on the shoulder, lane control signs, detection devices, ramp metering, and system integration. Spot safety improvements include new ramp configurations, ramp geometrical improvements, and ramp closures.

Transportation System Management

The outside shoulder of US 52 will be used for travel at specified locations from I-40 Business (US 421) to south of Akron Drive only during morning and afternoon peak periods. Providing an additional lane in each direction will maximize capacity on US 52 during times when the volume greatly exceeds the supply. Shoulder and bridge reinforcements are required to accommodate the additional travel lane. Estimated costs of additional asphalt pavement and overlay, provided by the Pavement Design Section, are \$284.43 and \$ 37.53 per linear meter, respectively. See Table 1 for an itemized list of estimated pavement reinforcements, overlay, and marking costs. The estimate does not include, however, costs incurred for obliteration of existing pavement.

PAVEMENT AND MARKING COSTS
TABLE 1

	LIMITS	LENGTH (m)	OVERLAY COSTS	PAVEMENT COSTS	MARKING COSTS
US 52 NB					
	5th St. entrance ramp to US 52 NB to proposed closed ramp at M. L. King, Jr. Dr.	612	\$46,000	\$275,500	\$10,500
	Proposed exit ramp from US 52 NB to M. L. King, Jr. Dr.	482		\$194,000	\$6,150
	Proposed entrance ramp from M. L. King, Jr. Dr. to US 52 NB	610		\$200,000	\$3,000
	Proposed interchange at M. L. King, Jr. Dr. to taper on US 52	585	\$44,000	\$84,000	\$16,300
	Proposed shoulder lane from MLK, Jr. Dr. to 25th St. exit ramp	4900	\$385,000	\$1.4 M	\$132,000
	Proposed shoulder lane from 25th St. to just south of Akron Dr.	1100	\$160,000	\$313,000	\$26,400
US 52 SB					
	16th St. entrance ramp to 11th St. exit ramp	1500	\$113,000	\$430,000	\$37,000
	11th St. entrance ramp to 5th St. exit ramp	2320	\$174,000	\$660,000	\$60,400
	Extend 11th St. from Liberty St. to MLK, Jr. Dr.	775		\$221,000	\$33,400
Subtotal Estimate		12,844	\$922,000	\$3.8 M	\$326,000

Advanced Transportation Management System

Lane control signs would be installed above each lane to indicate when free-flow conditions exist and when shoulder travel is permitted. The signs will be used to indicate a lane blockage due to an incident and to prohibit shoulder travel at certain times. A red "X" will be programmed to illuminate when there is a blockage in a particular lane or over a shoulder that is closed during non-peak conditions. During normal free-flow conditions, the sign will display a green arrow in each lane that applies.

During peak periods, the outside shoulder would be used for travel, thus eliminating storage area for stopped or stalled vehicles. Therefore, reliable detection devices are highly recommended to monitor traveling conditions on this corridor. These devices shall be placed in each lane at 1/2 mile intervals throughout the study area. If an incident occurs, the central computer would notify the respective personnel that a disruption in normal traffic flow has been detected. At this point, the lane control signs can be programmed to indicate a blockage in a particular lane.

Several ramps along US 52 experience excessively high volumes coupled with high accident rates caused by motorists attempting to weave on and off the freeway within the closely spaced interchanges. These high volume ramps are potential sites for ramp metering. The sites considered for this technology are as follows: Liberty St. to US 52 southbound, 5th St. to US 52 northbound, and Akron Dr. to US 52 northbound and southbound. Ramp metering regulates the entry of vehicles onto the freeway, at a given time, with a traffic signal. When a gap on the freeway is such that one or more vehicles can merge without disrupting the free-flow conditions, the signal turns green. If no sufficient gaps exist, the signal remains red. It is intended to maintain free flow conditions and increase capacity on this corridor.

System integration provides a means for the above measures to communicate with each other. Data commands can be compiled and transmitted from the field to the central computer with the development of a reliable communication system. Through system integration, various initiatives, linked together, will provide information concerning traffic conditions to state officials as well as the motoring public.

Spot Safety Improvements

The spot safety alternative includes improvements at specific locations along US 52 to relieve the particular congestion-related problem for that section of the corridor. These improvements are relatively low in cost and have minimal impact to the existing facility. As part of the spot safety improvements, various ramps will be closed in an attempt to provide additional merge and diverge area. Access ramps at the interchange of M. L. King, Jr. Dr. and US 52 northbound and southbound will be realigned to provide additional area for vehicles to transition to and from the freeway without impacting the existing free flow conditions. The ramp to access Liberty Street from US 52 northbound will be closed.

In order to approach Liberty Street, motorists can exit the freeway at the reconfigured M. L. King, Jr. Dr. exit and use the local surface streets. Due to its relatively low volumes, ramps at southbound US 52 and Northwest Boulevard will be closed. Motorists who need to access Northwest Boulevard should exit US 52 southbound at 25th Street and continue to Liberty Street then to Northwest Boulevard. High accident rates at the weaving area at 25th Street and US 52 northbound will be eliminated due to the closure of that entrance ramp. Motorists will have to use local streets to Akron Drive in order to enter the freeway in the northbound direction. Southbound traffic can use Liberty Street to access US 52 south.

The estimated total construction cost for the Traffic Management System alternative with minor spot safety improvements is \$14.3M. The majority of this system will be reusable during and after construction of future widening projects.

VI. Phases of Implementation

Following is a proposed schedule for the implementation of the phases of improvements. Refer to Figure 2 and Table 2 for a graphical illustration of the proposed phases and costs associated with each phase, respectively. This deployment strategy focuses on relatively low cost initiatives to be implemented when funding becomes available.

Phase I

Phase I improvements include eliminating access to US 52 from the Liberty Street and Northwest Boulevard interchanges. In addition, Sprague Street ramps and 3rd Street ramps that provide access to northbound and southbound US 52 shall be closed. The interchange at Martin Luther King, Jr. Drive should be re-configured as shown to accommodate the additional traffic that the US 311 extension will generate. Shoulders and auxiliary lanes on US 52, from 5th Street to Liberty Street, shall be reinforced so that the outside shoulder can be used as a twelve foot travel. This lane will be utilized for travel only during morning and afternoon peak periods.

Detection devices shall be installed along the corridor to provide information pertaining to travel speeds, travel conditions, traffic volumes and road surface conditions to a central computer. These devices, located every 1/3 mile in each lane, provide real-time traffic information for evaluation and/or data collection purposes. The computer can process the data and detect changes in traffic or surface conditions and alert appropriate traffic and emergency response personnel.

Other TSM improvements to be implemented in this phase involve ramp metering and system integration. Ramp metering shall be considered for the entrance ramp from 5th Street entrance ramp to US 52 northbound. This ramp is heavily used; therefore, ramp metering shall be used to regulate the flow of traffic that enters the freeway at this location. Additionally, a communication system to integrate the TSM improvements shall be developed at this stage.

Phase II

These improvements propose to eliminate access points at 25th and 26th Streets along with Stadium Drive. The shoulder and auxiliary lanes on US 52 shall be reinforced from Northwest Boulevard northward to the Southern railroad bridge before the interchange at Akron Drive and from Liberty Street south to the 5th Street exit ramp. Extending 11th Street from Liberty Street to Martin Luther King, Jr. Drive is also recommended for this phase. When roadway and ramp improvements have been completed, pavement markings shall be installed to include all improvements. Also, ramp metering shall be placed at Akron Dr. northbound and southbound ramps and Liberty St. to US 52 northbound in this phase.

Phase III

Lane control signs shall be mounted over each lane as part of this ATMS phase of implementation. The signs shall be in place to indicate when the shoulder can be used as a travel lane. A green arrow shall be displayed when free-flow conditions exist or a red "X" when there is a blockage in a particular lane or when shoulder use is prohibited to allow for a breakdown lane during non-peak hours. CMS and stationary signing would advise motorists on how to utilize shoulder lanes during peak periods. A sample display could be "USE SHOULDER LANE FOR TRAVEL- 6 A.M. - 9 A.M." or "TRAVEL ON SHOULDER 4 P.M. - 7 P.M. ONLY".

Any remaining pavement markings shall be placed during this phase to indicate that the shoulder can be used for travel.

U. S. 52 (FORSYTH COUNTY) PHASES OF IMPLEMENTATION

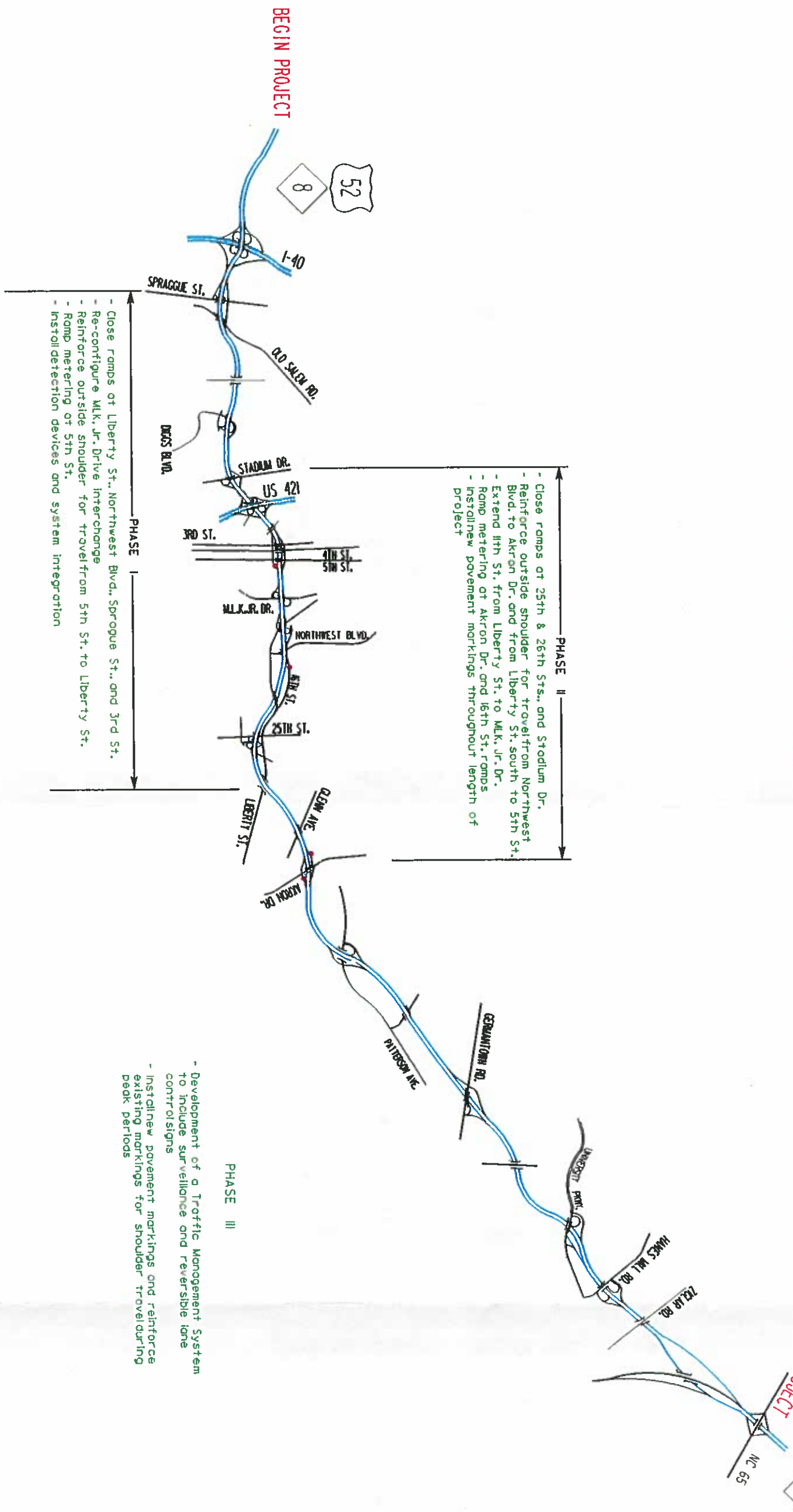


FIGURE 2

TABLE 2
IMPLEMENTATION OF PROJECTS

Project	Description	Cost
Phase I	<ul style="list-style-type: none"> • TSM Integration & software • Close ramps from northbound and southbound US 52 to Sprague Street • Close northbound and southbound entrance ramps from 3rd Street • Close exit ramp from US 52 northbound to Liberty Street • Close exit ramp from US 52 southbound to Northwest Blvd. • Re-configure the interchange at Martin Luther King, Jr. Dr. • Extend 5th Street entrance ramp and reinforce the outside shoulder at northbound US 52 to 300' north of existing Martin Luther King, Jr. Dr. • Ramp metering at 5th Street ramp to US 52 northbound and Liberty St. ramp to US 52 northbound • Install detection devices 	\$5,393,450
Phase II	<ul style="list-style-type: none"> • Close entrance ramps from the 25th and 26th Street interchange to northbound US 52 and from 25th Street to southbound US 52 • Eliminate all access points at Stadium Drive • From re-configured entrance ramp at MLK, Jr. Dr. to northbound US 52, reinforce shoulder to be used as travel lane to 25th St.. • Extend entrance ramp and reinforce shoulder from Liberty Street southbound to 11th Street exit ramp • Extend entrance ramp and reinforce shoulder from 11th Street southbound to 5th Street exit ramp • Extend 11th St. from Liberty St. to MLK, Jr. Dr. • Restripe pavement for 6 lanes of travel including shoulders from Northwest Blvd. to Akron Dr. • Ramp metering at Liberty St. to US 52 southbound and Akron Dr. ramps to US 52 northbound and southbound. 	\$4,245,200
Phase III	<ul style="list-style-type: none"> • Install Reversible Lane control signs 	\$600,000

VII. Accident Analysis

Accident reports for the study area of US 52 were compiled and analyzed by the Accident Studies section of the Traffic Engineering Branch. According to the report from May 1991 to April 1994, 53% of the accidents were rearend collisions that occurred during the morning and afternoon peak periods. An additional 24% involved vehicles that ran off the road in an effort to avoid stopped vehicles or slowing traffic (Figure 4). The total accident rate was 136.61acc/100mvm which is 75% higher than the statewide average for urban United States routes. This high percentage of accidents resulted from weaving difficulties associated with the closely spaced interchanges as vehicles attempted to enter and exit the freeway.

In addition, a statewide Wet Pavement accident study indicated that three of the top 53 accident sites were within this corridor. The three sites were the interchanges of US 52 and Akron Drive, US 52 and Sixteenth Street, and US 52 and Clemmons Road. Although these sites are significant in the Wet Pavement accident study, it is believed that severe traffic congestion and difficult weaving maneuvers contributed greatly to causing a majority of the accidents. Therefore, closing low volume ramp access points and metering existing high volume ramps will eliminate the weaving problems at these interchanges and promote safer maneuvering.

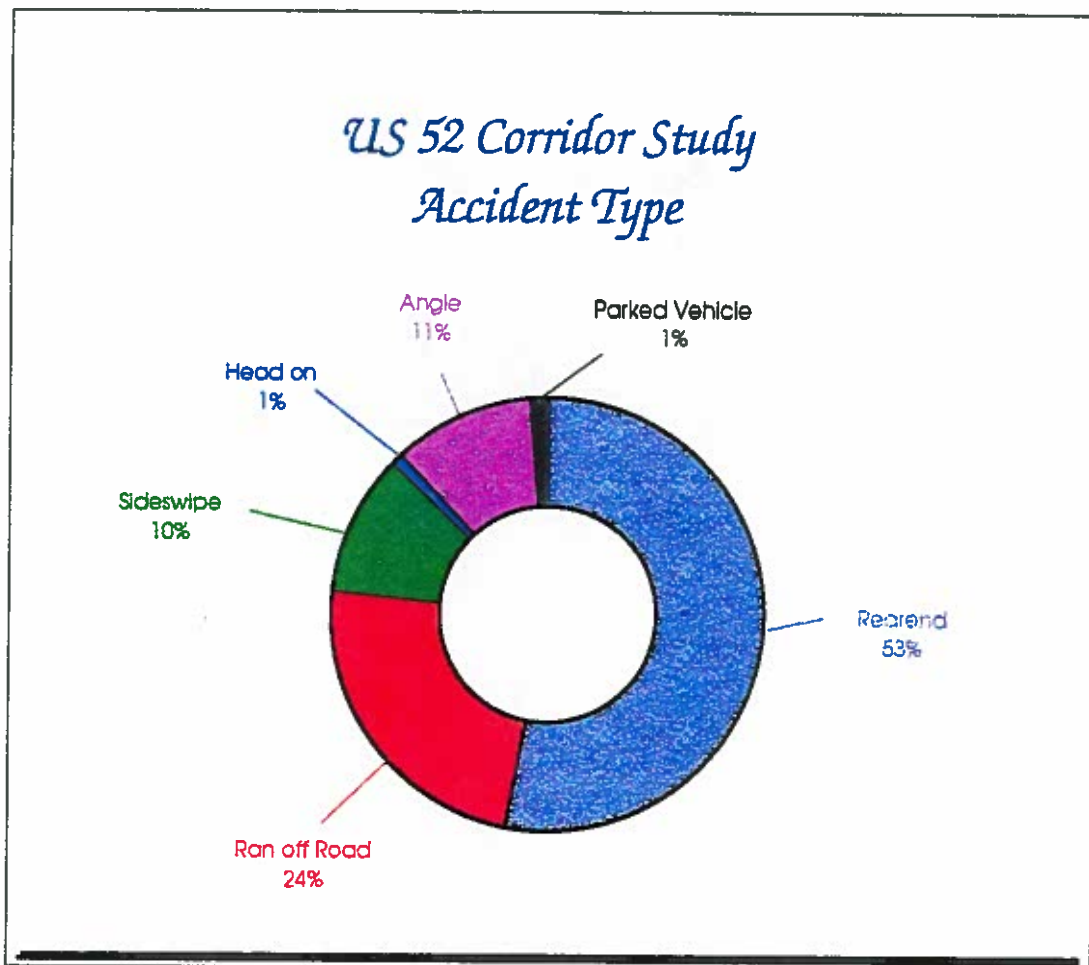
VIII. Summary of Recommendations

The recommendations summarized below include a combination of Traffic System Management (TSM) as well as minor Spot Safety improvements. TSM improvements include advanced transportation and congestion management enhancements which maximize the operational efficiency of the existing roadway. US 52 is an older freeway characterized by short acceleration/deceleration lengths, short weaving lengths, and low-speed ramp geometry. Because of these characteristics, capacity problems occur at ramp junctions resulting in sudden lane changes and speed reductions on the freeway. Consequently, incidents are more likely to occur followed by a subsequent breakdown of the system.

The TSM improvements will improve the operation of the facility by implementing advanced technologies to address and reduce congestion concerns. Non-intrusive sensors will detect the presence of vehicles, speeds, and determine if an incident has occurred. When a vehicle stops at or passes the sensor, it records the presence or passage of that vehicle. This data is transmitted to the central computer where it is compiled and analyzed to determine real-time traffic conditions.

US 52 CORRIDOR ACCIDENT STUDY

Type of Accident	Number
Rearend	379
Ran off Road	170
Sideswipe	75
Head on	6
Angle	77
Parked Vehicle	9



An additional travel lane in each direction will maximize capacity on US 52 during times when the volume greatly exceeds the supply. According to the Highway Capacity Manual and Software, this four lane facility functions at a severe Level of Service F (LOS F) during peak periods. LOS F describes traffic conditions where the number of vehicles arriving is greater than those leaving a particular point. Traffic experiences short periods of movement followed by periods of stoppages which cause driver frustration and anxiety.

Using the Highway Capacity Software (HCS), the LOS of the corridor was analyzed with shoulder lane used as an additional travel lane during peak periods. An improvement from LOS F to LOS D was exhibited within the CBD. Although LOS D is the level where speeds begin to decline, daily commuters will experience a significant improvement compared to the existing conditions.

The spot safety alternative includes relatively low cost improvements implemented at specific locations along US 52. These improvements are recommended to relieve particular congestion-related problems with minimal impact to the existing facility. Ramp closures, ramp geometrical improvements, and new ramp configurations are included in the spot safety alternative. In addition, lengthening auxiliary lanes, wherever possible, will improve ramp operations as motorists enter and exit the freeway. These improvements can be implemented in stages and incorporated into any future widening construction.

IX. COST ISSUES:

An estimated cost of the recommended improvements for US 52, excluding pavement obliteration and right of way, is as follows:

ACTIVITY	ESTIMATED COST
Structure w/ 6 Lane Control Signs @ 1/2 mi. spacing	\$600,000
Traffic Management System <ul style="list-style-type: none"> • Central computer • detection • surveillance • communications 	\$3,000,000
System Integration	\$1,000,000
Ramp Metering @ 4 locations	\$200,000
Pavement Reinforcement	\$3,800,000
Pavement Overlay	\$922,000
Pavement Marking	\$326,000
Pavement Obliteration	unknown
Right of Way	unknown
Traffic Control	\$985,000
Construction and Administration	\$1,100,000
Design	\$2,400,000
Total Engineering	\$14.2 M

X. CONCLUDING REMARKS

Recent studies have suggested that a significant amount of the day to day congestion is a direct result of excessive traffic volumes utilizing the facility. It is suggested that as much as 40 percent of freeway congestion is caused by daily commuters. Linking the recommended strategies with proposed improvement projects will work to actively address congestion mitigation described herein. The implementation of this physical system and integration of these systems can have a significant impact on improving safety and increasing capacity on the US 52 corridor on a daily basis.

